OPERATION AND CALIBRATION INSTRUCTIONS

SERIES MX-1
DIGITAL VOLTMETER

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

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CHAPTER I

INTRODUCTION AND SPECIFICATIONS

1-1. GENERAL

The Series MX-1 Digital Voltmeter is a solid-state digital measuring instrument with five full digits and a sixth digit which provides a 20 percent over-range capability, except in the 1,000-volt range for DC and AC volts measurement. Polarity of signal input is displayed automatically and range changing may be either automatic, or manually controlled as selected by front-panel switches.

The instrument measures DC voltages in 5 ranges from .000001 volt to ±1000.00 volts. The instrument measures +DC/+DC voltage ratio X 10 (with +1 volt to +10.5 volts reference input) in 5 ranges from +.000001 to +1000.00; and, with an optional AC/DC converter accessory, AC voltages in four ranges from 0.00001 volt to 1000.00 volts. Also with the optional AC/DC converter the instrument measures AC/DC voltage ratio X 10 in 4 ranges from 0.00001 to 1000.00. With an optional KΩ/DC converter accessory, the instrument measures resistance in 6 ranges from .000001KΩ to 11999.9KΩ. Isolated data output, input cables and rack-mounting adapters are also offered as optional accessories.

1-2. DESCRIPTION

The voltmeter is portable, weighing less than 15 pounds. A carrying handle is provided which also serves as a tilt-stand for the unit. By removal of the top and bottom covers of the instrument, internal calibration and adjustment controls are easily reached and clearly labeled. Power application and function and range selection are accomplished by activation of pushbutton switches on the front panel. Signal input binding posts, located on the front and rear of the instrument, will accept standard test leads or leads equipped with banana plugs. The powerline cord is permanently attached to the rear of the unit and terminates in a three pin polarized plug. The powerline fuse is externally located in an extractor post on the rear of the instrument.

In operation, the unknown input voltage applied to the instrument is buffered and used to charge a capacitor during a specific time internal. An internal reference is then applied to discharge the capacitor. Measuring the time interval required to discharge the capacitor indicates the unknown input which is visually displayed in neon glow tubes at the front of the instrument.

1-3. SPECIFICATIONS - GENERAL

Estimated MTBF: 10,000 hours

Display: In-line neon tube display of numerals

Maximum Inputs:

"HI" to "LO": See individual function specifications.

"LO" to Guard: ±100 volts

Guard to Ground: ±1000 VDC or peak AC

Operating Temperature Range: 0°C to +50°C

Non-Operating Temperature Range: -40°C to +75°C

Operating Humidity Range:

0°C to 25°C - 80% relative humidity, max.

25°C to 50°C - 70% relative humidity, max.

Operating Altitude: 10,000 feet, max.

Non-Operating Altutide: 50,000 feet, max.

Shock & Vibration: Meets requirements of MIL-T-21200 and MIL-E-16400.

Power: 105-125/210-250V, 50 to 440 Hz, less than 20 watts with all options

Warm-Up Time: 30 minutes to meet all specifications

Weight:

Basic Instrument: Less than 15 lbs.

Basic Instrument Plus All Options: Less than 19 lbs.

Over-all Dimensions: 8-1/2"W x 3-1/2"H x 15"D

1-4. SPECIFICATIONS - DC VOLTS

Ranges	Resolution	Input Resistance
±.100000 volts	1 μV	100 megohms, min.
±1.00000 volts	10 μV	1000 meghoms, min.
±10.0000 volts	100 μV	10,000 megohms, min.
±100.000 volts	1 mV	10 megohms
±1000.00 volts	10 mV	10 megohms

Over-range: 20% (1000V. maximum)

Input Overload Voltage: 1000 VDC or RMS (1500V peak AC) overload with no damage (any range)

Range Selection: Automatic and Manual

Polarity Selection: Automatic

Accuracy: (4 higher ranges)

24 hours, 23°C ±1°C
±(0.005% of input + 0.002% of range)

30 days, 20°C to 30°C
±(0.008% of input + 0.002% of range)

90 days, 20°C to 30°C
±(0.01% of input + 0.002% of range)

6 months, 20°C to 30°C
±(0.01% of input + 0.004% of range)

1 year, 20°C to 30°C
±(0.015% of input + 0.005% of range)

Accuracy: (0.1-Volt Range)

24 hours, 23°C ±1°C
±(0.005% of input + 0.004% of range)

90 days and 6 months, 20°C to 30°C
±(0.01% of input + 0.01% of range)

1 year, 20°C to 30°C
±(0.015% of input + 0.01% of range)

Temperature Coefficient: (4 higher ranges)

0°C to 20°C, 30°C to 50°C
±(0.0005% of input + 0.0005% of range)/°C

Temperature Coefficient: (0.1-Volt Range)

0°C to 20°C, 30°C to 50°C
±(0.0007% of input + 0.001% of range)/°C

Filtering: Two-pole active filter followed by integration in the A/D conversion

Normal-Mode Rejection:

3 Higher Ranges

Greater than 60 db at 50 Hz

2 Lower Ranges

Greater than 55 db at 50 Hz
Greater than 60 db at 60 Hz and above

Common-Mode Rejection in 1000 Ohms unbalance in either lead:

3 Higher Ranges

Greater than 140 db at DC
Greater than 140 db at 60 Hz and above

2 Lower Ranges

Greater than 140 db, DC to 60 Hz

Maximum Common-Mode Voltage: 1000 VDC or peak AC

Response Time to within 0.01% of step function change, including polarity change:

4 Higher Ranges

1 second, max.*

0.1-Volt Range*

3 seconds, max.

*Response time figures applicable for source resistances up to 50 kilohms.

1-5. SPECIFICATIONS - +DC/+DC VOLTS RATIO X 10

Ratios Obtainable: +DCV/+DCV (standard) or ACV/DCV (with Option A or B)

Ranges: Same as DC volts (or AC volts) except that reading displayed is the ratio X 10.

Over-Range: 20%

Range Selection: Automatic and manual

Polarity Selection: Automatic

Accuracy: Same as DC volts (or AC volts) except "% of range" is multiplied by 10V/E ref.

Reference Voltage: +1 volt to +10.5 volts DC

Reference Input Resistance: Greater than 1000 megohms

Response Time of Reference to within 0.01% of step function change:

Less than 1 second

Reference Normal-Mode Rejection: Greater than 60 db at 60 Hz

Isolation: Reference common can be positive with respect to input common by 1 volt, maximum. Reference common can be negative with respect to input common by 10 volts, maximum.

1-6. SPECIFICATIONS - AC VOLTS

Ranges	Resolution
1.00000 volt	10 microvolts
10.0000 volts	100 microvolts
100.000 volts	1 millivolt
1000.00 volts	10 millivolts

Over-range: 20%

Maximum Input Voltage: 1000V RMS (1500 V Peak)

Maximum Volt-Hertz Product: 2×10^7

Range Selection: Automatic and Manual

Sensing and Calibration: True-average sensing, calibrated in RMS of sinewave

Accuracy, 20°C to 30°C:

50 Hz to 10KHz

±(0.1% of input + 0.05% of range)*
+ 0.06% of range) 30 days
+ 0.065% of range) 90 days
+0.07% of range) 6 months

*"±0.05% of range" accuracy can be obtained at any time during a six month period via front panel AC zero. ±0.05% is typically maintained for 24 hours following zero adjustment. 30-day, 90-day, and 6-month intervals start after the last use of the AC zero.

30 Hz to 50 Hz and 10 KHz to 20 KHz

±(0.5% of input + 0.1% of range)*
+ 0.105% of range) - 30 days
+ 0.11% of range) - 90 days
+ 0.115% of range) - 6 months

*See footnote, preceding page.

Temperature Coefficient:

0°C to 20°C, 30°C to 50°C:

±(0.006% of input + 0.003% of range)/°C

Response Time to within 0.1% of step function Change: Less than 1 second

Common-Mode Rejection, DC to 60 Hz: Greater than 120 db with 100 ohms unbalance in either lead

Maximum Common-Mode Voltage: 1000V DC or Peak AC

1.7 SPECIFICATION - K OHMS

Ranges	Resolution	Test Current (Max)
.100000 kilohm	1 milliohm	10 milliamperes
1.00000 kilohm	10 milliohms	10 milliamperes
10.0000 kilohms	100 milliohms	100 microamperes
100.000 kilohms	1 ohm	100 microamperes
1000.00 kilohms	10 ohms	1 microampere
10000.0 kilohms	100 ohms	1 microampere

Over-range: 20%

Range Selection: Automatic and Manual

Accuracy: 20°C to 30°C:

.1KΩ to 100KΩ

±(0.01% of input + 0.002% of range) - 90 days
±(0.01% of input + 0.004% of range) - 6 months
±(0.015% of input + 0.005% of range) - 1 year

1000KΩ

±(0.02% of input + 0.002% of range) - 90 days
±(0.02% of input + 0.004% of range) - 6 months
±(0.05% of input + 0.005% of range) - 1 year

10,000KΩ

±(0.05% of input + 0.002% of range) - 90 days
±(0.05% of input + 0.004% of range) - 6 months
±(0.06% of input + 0.005% of range) - 1 year

Temperature Coefficient, 0°C to 20°C and 30°C to 50°C:

.1KΩ to 1000KΩ

±(0.0007% of input + 0.0003% of range)/°C

1000KΩ

±(0.003% of input + 0.0003% of range)/°C

Response Time to within 0.01% of Step Function Change:

.1KΩ to 100KΩ

500 milliseconds

1000KΩ

1.0 second

10,000KΩ

3.0 seconds

Configuration: 4-wire on all ranges

Maximum Input Voltage: 30V RMS opens protective fuse

CHAPTER II

INSTALLATION AND OPERATION

2-1. UNPACKING

The instrument is shipped in a sturdy cardboard container. Cut the tape on top of the box and open. Remove the technical manual, cushioning material, test leads and instrument. Replace cushioning material and preserve container for future use. If damage is observed, promptly notify the carrier. Immediately check the packing slip for possibility of shortages.

2-2 INSTALLATION

The digital voltmeter is portable and self-contained, and requires no installation other than tilt-stand adjustment, power connection to a suitable AC power source, and assurance that the readout will properly "zero" (paragraph 2-8).

a. Tilt-Stand. The carrying-handle of the instrument also serves as a tilt-stand for the unit.

1. Slightly loosen (turn counter clockwise) the two knobs attaching the handle to the frame of the instrument.

2. Raise the front of the instrument and pull the front of the handle forward and then press downward and underneath the unit until the front of the handle (now the base of the stand) is in such a position to provide the desired angle to the instrument for easy observation of the digital readout.

3. Tighten the two knobs attaching the stand to the frame.

NOTE

Always loosen the knobs before repositioning the handle. Never force the handle to a new position while the knobs are tight.

b. Fuse. The instrument is shipped with a 0.25 ampere slow-blow fuse inserted in the fuseholder on the rear of the unit. The fuse is suitable for either 115-volt or 230-volt operation.

2-3. POWER SOURCE

The instrument is usually supplied for operation from 105-125-volt, 60-400 Hz, single phase power sources. However, the instrument will operate from 210-250-volt sources if the two primaries of the power tranformer are wired in series instead of parallel.

2-4. POWER GROUNDING

The third pin of the power plug grounds the outer chassis of the instrument (Figure 2-1). Despite the presence of the third grounding pin, there is no real assurance that the instrument will be correctly connected since the power outlets in many installations are erroneously wired. Be certain that the power source is in agreement with the power and grounding requirements of the instrument.

2-5. CONTROLS, INDICATORS AND INPUT JACKS

Refer to Table I for a description of operating controls, indicators and input jacks.

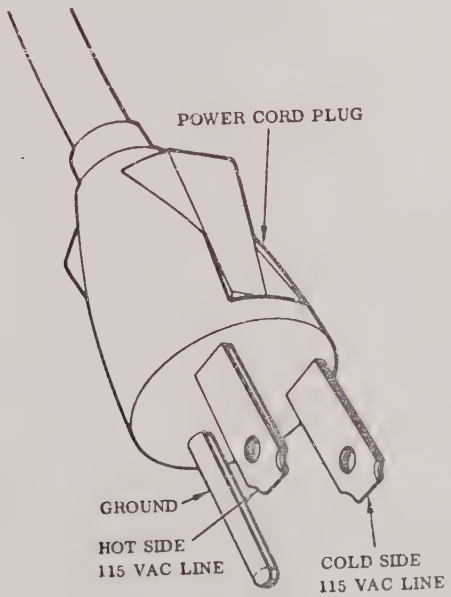


Figure 2-1. Power Plug Pin Coding

Table I. Operating Controls, Indicators and Input Jacks

DESCRIPTION	FUNCTION
PWR ON pushbutton switch	Applies VAC line power to the instrument.
AUTO RNG pushbutton switch	Selects automatic ranging mode of operation.
RNG CHNG pushbutton switch	Changes range of instrument if AUTO RNG switch is in the "out" position.
SIG HI input jack	Front and rear jacks connect to instrument signal input.
SIG LO input jack	Front and rear jacks connect to instrument signal common.
GUARD input jack	Front and rear jacks connect to inner guard shield.
Ω/+ REF input jack	Front and rear jacks are + current connections for ohms or "+" external reference voltage input.
Ω/- REF input jack	Front and rear jacks are - current connections for ohms or "-" external reference voltage input.
Overload indicator (Ł)	Incandescent bulb behind mask flashes Ł symbol when input voltage exceeds full scale capability of range selected if in manual range, or overall instrument capability if in AUTO RNG mode.
Polarity indicators	Incandescent bulbs behind mask indicate polarity of DC voltage applied to SIG HI terminal with respect to SIG LO terminal in VDC and ratio modes.
Readout tubes	Gas discharge display tubes which provide the readout in digital and decimal form. There are six plug-in tubes, each containing the numerals 0 thru 9 and a decimal point.
VAC pushbutton switch	Places the instrument in the AC voltage measurement mode if an AC/DC converter accessory is installed.

Table I. Operating Controls, Indicators and Input Jacks (Con't)

DESCRIPTION	FUNCTION
VDC pushbutton switch	Places the instrument in the DC voltage measurement mode.
KΩ pushbutton switch	Places the instrument in the ohms measurement mode.
R X 10 pushbutton switch	Places the instrument in the ratio measurement mode. The reading displayed is the ratio X 10 of the input voltage to the reference voltage. When making a ratio measurement it is necessary that a VAC or VDC switch also be depressed as desired.

2-6. OPERATION

2-7. STARTING PROCEDURE

a. Plug the power cord connector into the selected AC outlet.

b. Depress PWR ON pushbutton switch. Allow 30 minutes for instrument warm-up.

2-8. ZEROING THE READOUT

a. Connect signal input voltage leads to instrument as shown in figure 2-2.

b. Connect the terminals of the input leads together.

c. Be sure that the VDC and AUTO RNG pushbutton switches are in the "in" position and the R X 10 switch is "out."

d. The instrument readout should display .000000 + or - 1 digit. If it does not, adjust the VDC zero adjust potentiometer (R1) by inserting a small screwdriver in the opening directly underneath the VDC pushbutton switch and turning the adjustment screw until the readout displays ±.000000. Due to noise the readout will occasionally be ±.000001. The MX-1 is now ready to make measurements accurately, conveniently and quickly.

2-9. MEASUREMENT OF DC VOLTAGE

a. Ensure a zero readout (paragraph 2-8).

b. Connect terminals of GUARD and SIG LO input leads together.

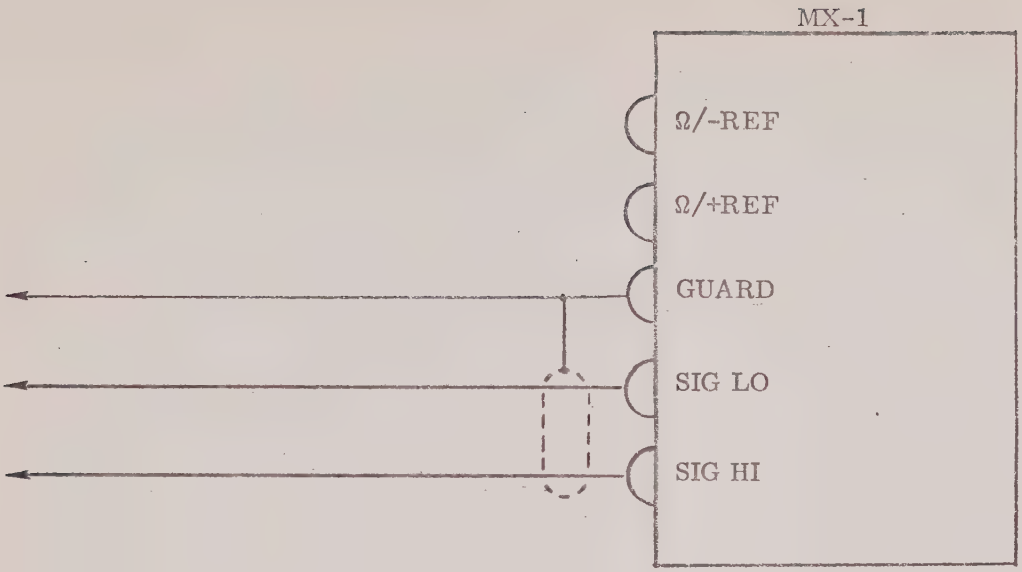


Figure 2-2. Voltage Input Cable Connections

WARNING

If high voltages are to be measured, use extreme caution. Serious injury or death may result from contact with terminals connected to high voltage sources.

CAUTION

See figure 2-3 for maximum voltages which may be applied to the input jacks of the instrument without causing damage.

c. Connect terminal of SIG LO input lead to DC common of voltage source and terminal of SIG HI lead to voltage source.

d. The voltmeter will select the proper range automatically, displaying the voltage, decimal point and polarity of the input to the SIG HI jack with respect to the input of the SIG LO jack.

e. To select a voltage range manually, depress AUTO RNG push-button switch, bringing it to the "out" position. Note position of decimal point. Depress RNG CHNG pushbutton switch as required to reach desired range.

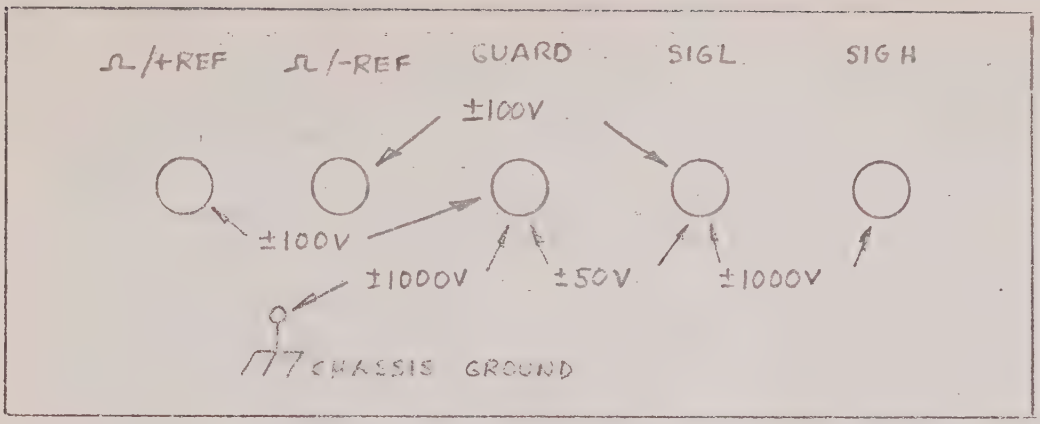


Figure 2-3. Maximum voltages which may be applied to inputs of Series MX-1 without causing damage

2-10. MEASUREMENT OF +DC/+DC VOLTAGE RATIO

a. Ensure a DC zero readout (paragraph 2-8).

b. Depress the R X 10 pushbutton.

c. Connect reference voltage and ohms input leads to instrument as shown in figure 2-4.

d. Connect the terminals of GUARD and SIG LO of the signal input leads together.

WARNING

If high voltages are to be measured, use extreme caution. Serious injury or death may result from contact with terminals connected to high voltage sources.

CAUTION

See figure 2-3 for maximum voltages which may be applied to the input jacks of the instrument without causing damage.

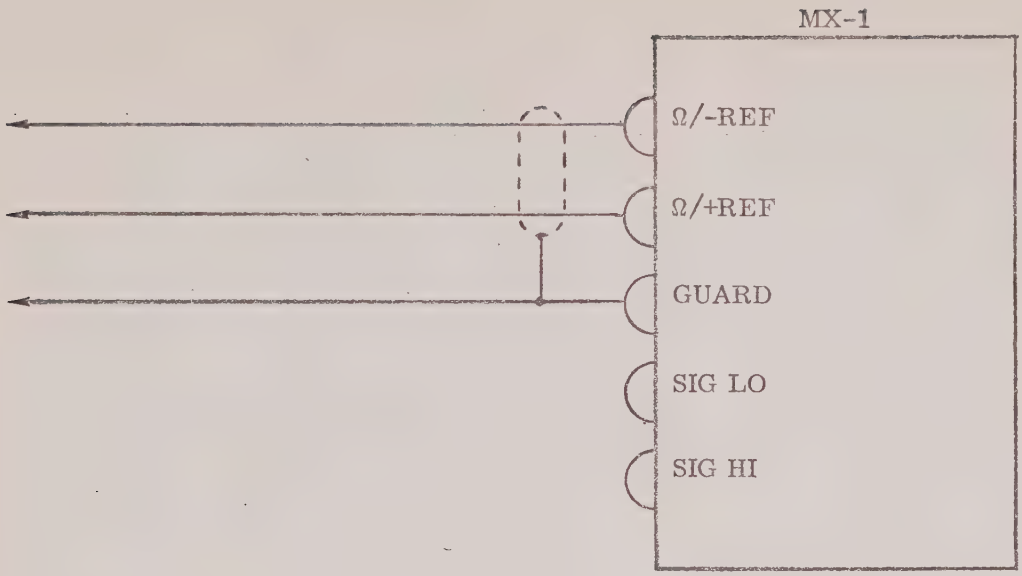


Figure 2-4. Reference Voltage Cable Connections

e. Connect the terminal of SIG LO input lead to DC common of voltage source and the terminal of SIG HI input lead to voltage source.

NOTE

The MX-1 makes a four-terminal measurement in the ratio mode. Therefore, both reference leads must be connected to the reference source and both input leads to the signal source. If the two voltages are isolated from each other, then the two commons must be connected together. See figure 2-5 for typical ratio application connections.

f. Connect the terminal of Ω/- REF of input lead to DC common of reference voltage source and Ω/+ REF input lead to reference voltage source.

f. The readout of the instrument will display 10 X (the ratio X 10 of the input voltage to the external reference voltage).

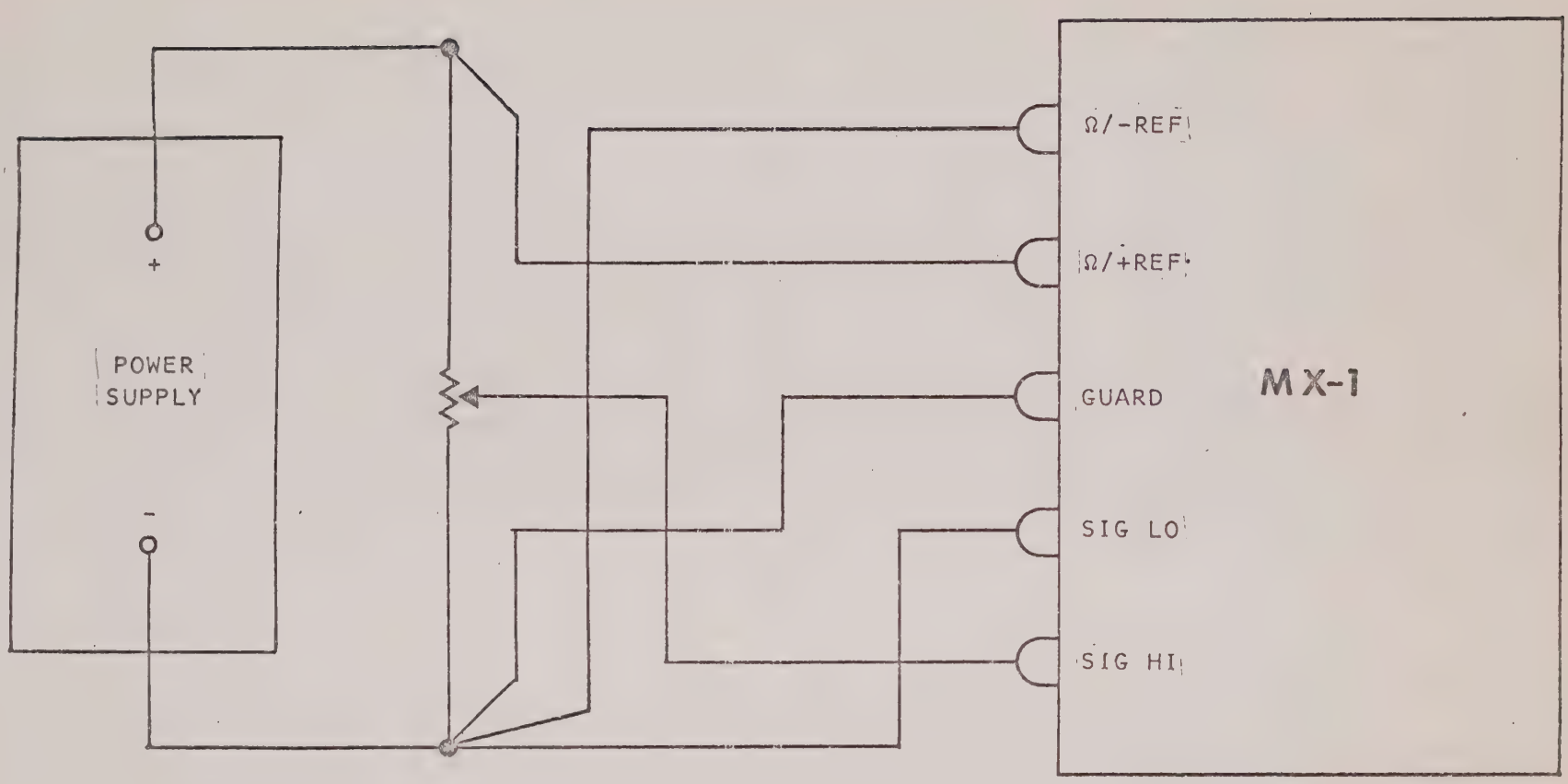


Figure 2-5. Typical Ratio Application

2-11. MEASUREMENT OF AC VOLTAGE

a. Ensure a dc zero readout (paragraph 2-8).

b. Press the VAC pushbutton.

c. With the clips of the signal input voltage leads remaining together, follow the zeroing procedure (paragraph 2-8e) except adjust the VAC zero adjust potentiometer (R7) directly underneath the VAC pushbutton to achieve 0.00000 or 0.00001.

d. Connect the terminals of SIG LO and GUARD of signal input voltage leads together.

WARNING

If high voltages are to be measured, use extreme caution. Serious injury or death may result from contact with terminals connected to high voltage sources.

CAUTION

See figure 2-3 for maximum voltages which may be applied to the input jacks of the instrument without causing damage.

e. Connect the terminal of SIG LO input lead to AC common of voltage source and terminal of SIG HI input lead to voltage source.

f. The voltmeter will select the proper range automatically, displaying the voltage and decimal point of the input to the SIG HI jack with respect to the input of the SIG LO jack.

g. To select a voltage range manually, depress AUTO RNG pushbutton switch, bringing it to the "out" position. Note position of decimal point. Depress RNG CHNG pushbutton switch as required to reach desired range.

2-12. MEASUREMENT OF AC/DC VOLTAGE RATIO

a. Ensure a DC and AC zero readout (paragraphs 2-8 and 2-11).

b. Press the VAC pushbutton.

c. Connect reference voltage input leads to instrument as shown in figure 2-4.

d. Connect the terminals of SIG LO and GUARD of signal input voltage leads together.

WARNING

If high voltages are to be measured, use extreme caution. Serious injury or death may result from contact with terminals connected to high voltage sources.

CAUTION

See figure 2-3 for maximum voltages which may be applied to the input jacks of the instrument without causing damage.

e. Connect the terminal of SIG LO input lead to AC common of voltage source and the terminal of SIG HI input lead to AC voltage source (figure 2-6).

NOTE

The MX-1 makes a four-terminal measurement in the ratio mode. Therefore, both reference leads must be connected to the reference source and both input leads to the signal source. If the two voltages are isolated from each other, then the two commons must be connected together. See figure 2-5 for typical ratio application connections.

f. Connect the terminal of Ω/-REF to DC common of reference voltage source and the terminal of Ω/+REF lead to DC reference voltage source (Figure 2-6).

g. The readout of the instrument will display the ratio X 10 of the AC input voltage to the DC reference voltage.

2-13. MEASUREMENT OF RESISTANCE

a. Ensure a DC zero readout (paragraph 2-8).

b. Press KΩ and AUTO RNG pushbuttons.

c. Connect input leads to instrument as shown in figure 2-4.

d. Connect the terminals of SIG LO and GUARD of signal input voltage leads together.

e. Connect the resistance source between SIG LO and Ω/-REF leads and SIG HI and Ω/+REF leads.

f. The instrument will select the proper range automatically, displaying the resistance value in KΩ.

g. To select a range manually, depress AUTO RNG pushbutton switch, bringing it to the "out" position. Note position of decimal point. Depress RNG CHNG pushbutton switch as required to reach desired range.

2-14. STOPPING PROCEDURE

To stop the digital voltmeter, depress PWR ON pushbutton switch, bringing it to the "out" position. Disconnect test leads and remove power cord from AC power source.

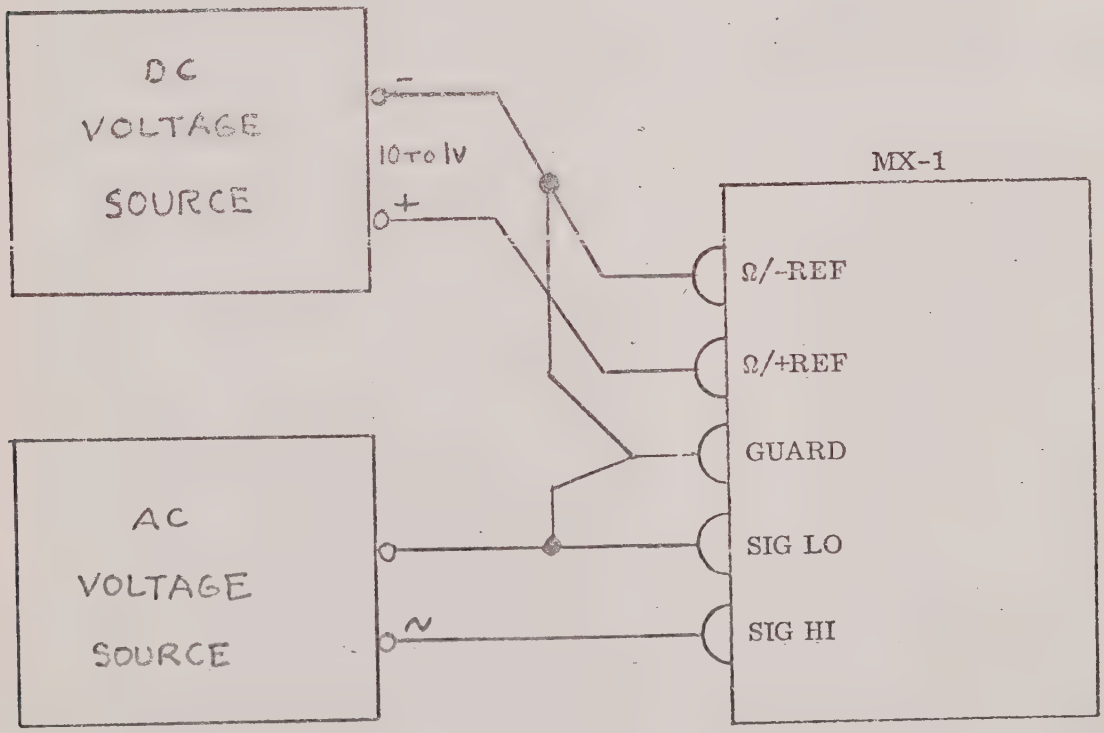


Figure 2-6. AC/DC Voltage Ratio Connections

CHAPTER III

CALIBRATION

3-1. GENERAL

A calibration cycle of 6 months is sufficient for areas of normal operating conditions. The calibration of any instrument changes slightly with age, use, and operating conditions. Also, problemts which may not be apparent during normal use will show up during a calibration check.

NOTE

The DC/DC ratio and VDC calibration procedures must be successfully carried out before the AC/DC or the KΩ calibrations are attempted.

3-2. TEST EQUIPMENT REQUIRED

a. DC voltage standard, John Fluke Model 332A, or equivalent.

b. Audio voltage standard, Holt Model 631B, or equivalent.

c. Ohms standard, E.S.I. Model DB52, or equivalent.

3-3. CALIBRATION PROCEDURE

3-4. INITIAL PREPARATION

a. Remove power cord from power outlet.

b. Turn fuse holder cap counter clockwise and remove it from the body of the fuse holder.

c. Remove top and bottom covers by removing two screws in each at rear of instrument and moving covers away and back toward rear of instrument.

d. Replace fuse and insert power cord into AC outlet.

e. Depress PWR ON pushbutton switch. Allow 30 minutes for instrument warm-up.

f. Be sure that the VDC and AUTO RNG pushbutton switches are in the "in" position.

g. It will be noted that the top shield displays the sequence numbers of calibration of each adjustment potentiometer for DC volts and ratio calibration.

3-5. ZEROING THE READOUT

Zero the readout in accordance with instructions contained in paragraph 2-8.

3-6. RATIO ADJUSTMENT

a. Connect the instrument as shown in figure 3-1.

b. Press R X 10 pushbutton switch.

CAUTION

With the instrument connected as shown in figure 3-1, never apply more than 100 VDC from the voltage standard or damage may result.

c. Set voltage standard to +10.00000 volts.

d. The numerical value displayed in the readout should be equal to +10.0000. If not, adjust .10V RATIO (2) potentiometer until the readout displays the correct value.

e. Disconnect the reference leads from the voltage source and release the R X 10 button.

3-7. VDC RANGE ADJUSTMENTS

a. Connect the instrument as shown in figure 3-2.

b. Press the VDC pushbutton switch.

c. Set the voltage standard to +10.00000 volts.

d. The numerical value displayed in the readout should be equal to +10.0000. If it is not, adjust the 10 VDC (3) potentiometer until the readout displays the correct value.

e. Set the voltage standard to +1.00000 VDC.

f. The numerical value displayed in the readout should be equal to +1.00000. If it is not, adjust the 1 VDC (4) potentiometer until the readout displays the correct value.

g. Set the voltage standard to +0.100000 VDC.

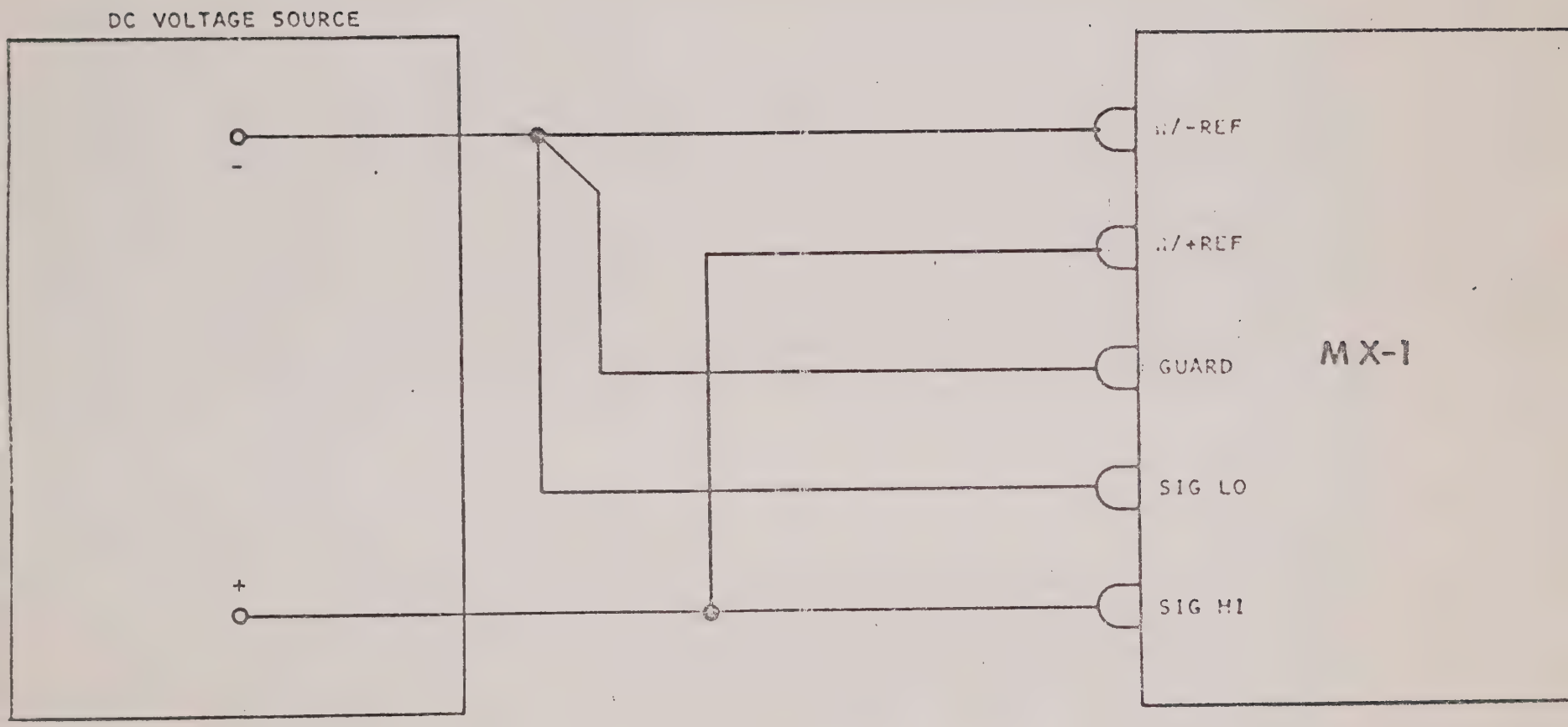


Figure 3-1. Ratio Adjustment Connections

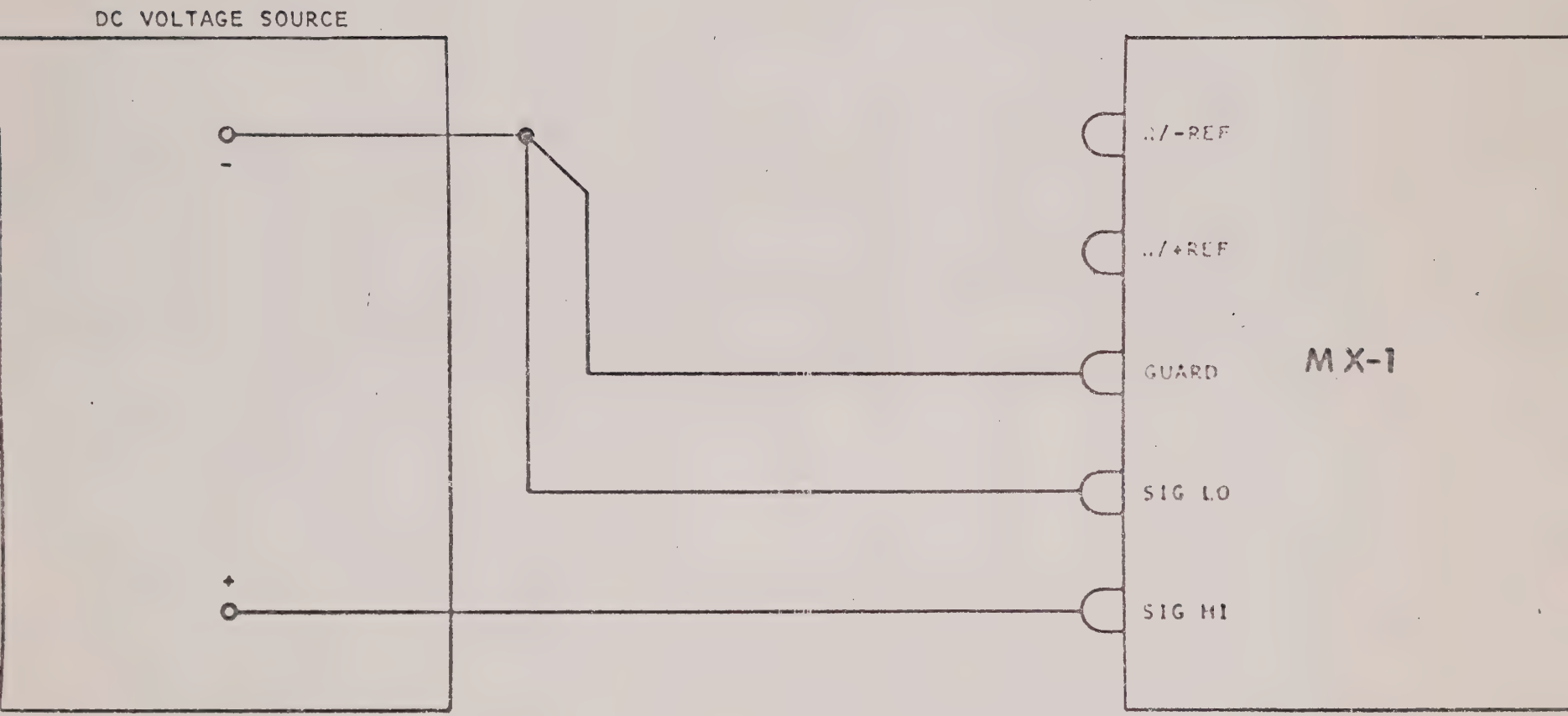


Figure 3-2. DC Voltage Adjustment Connections

h. The numerical value displayed in the readout should be equal to +.100000. If it is not, adjust the 0.1 VDC (5) potentiometer until the readout displays the correct value.

WARNING

Use extreme caution in performing the following steps as dangerously high voltages may be employed.

i. Set the voltage standard to +100.000 volts.

j. The numerical value displayed in the readout should be equal to +100.000. If it is not, adjust the 100 VDC (6) potentiometer until the readout displays the correct value.

3-8. AC/DC CONVERTER ADJUSTMENT

a. Ensure a DC zero readout (paragraph 2-8).

b. Depress the VAC pushbutton switch.

c. With the clips of the input cable remaining together, follow the zeroing procedure (paragraph 2-8e) except adjust the VAC zero adjust potentiometer (7) directly underneath the VAC pushbutton.

d. Connect the instrument to the audio voltage standard as shown in figure 3-3.

e. Set the audio voltage standard to 1 VAC @ 60 Hz. The readout should display 1.00000. If it does not, adjust the 1 VAC-60Hz (8) calibration potentiometer (figure 3-4) until it does.

f. Set the audio voltage standard to 1 VAC @ 10,000 Hz. The readout should display 1.00000. If it does not, adjust the 1 VAC-10 KHz (9) calibration potentiometer (figure 3-4) until it does.

WARNING

Use extreme caution in performing the following steps as dangerously high voltages will be employed.

g. Set the audio voltage standard to 500 VAC @ 60 Hz. The readout should display 500.00. If it does not, adjust the 500 VAC-50 Hz (10) calibration potentiometer (figure 3-4) until it does.

h. Check the calibration at other voltages and frequencies. If some point lies outside the rated accuracy limits, it may be brought in by a slight miscalibration at the above three set points.

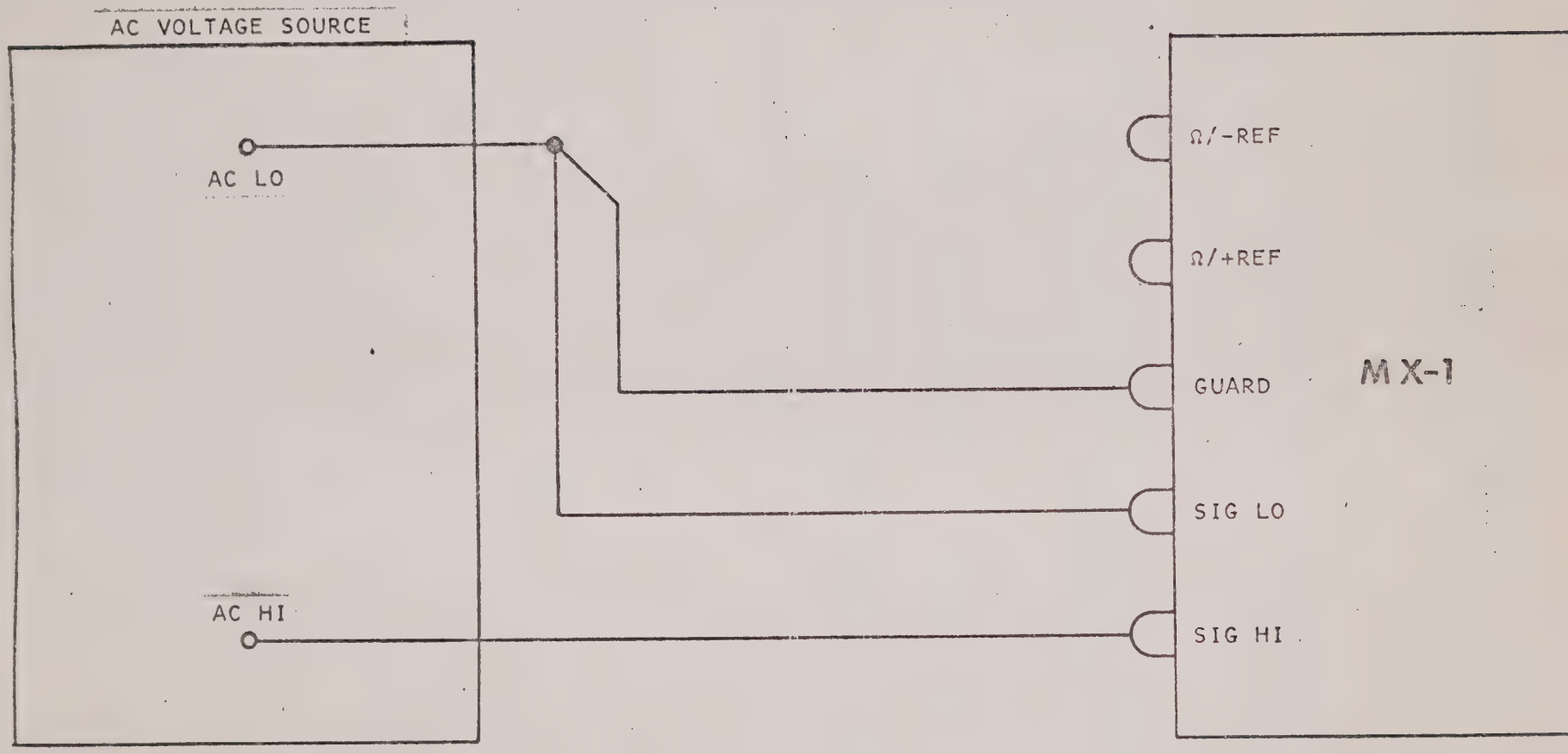


Figure 3-3. AC Voltage Adjustment Connections

3-9. KΩ/DC CONVERTER ADJUSTMENT

a. Connect the instrument as shown in figure 3-5.

b. Ensure a DC zero readout (paragraph 2-8)

c. Depress the KΩ pushbutton switch.

d. Connect the instrument to a decade resistant standard (E.S.I. Model DB52).

e. Set the standard to 100.000KΩ.

f. The numerical value displayed in the readout should be equal to 100.000. If it is not, adjust the 100KΩ (11) potentiometer until the readout displays the correct value.

g. Set the standard to 1.00000KΩ.

h. The numerical value displayed in the readout should be 1.00000. If it is not, adjust the 1KΩ (12) potentiometer until the readout displays the correct value.

i. Check the calibration at other resistance settings. If some point lies out of the rated accuracy limits, it may be brought in by a miscalibration at the above two set points.

j. Disconnect test leads and power cord, and reassemble instrument.

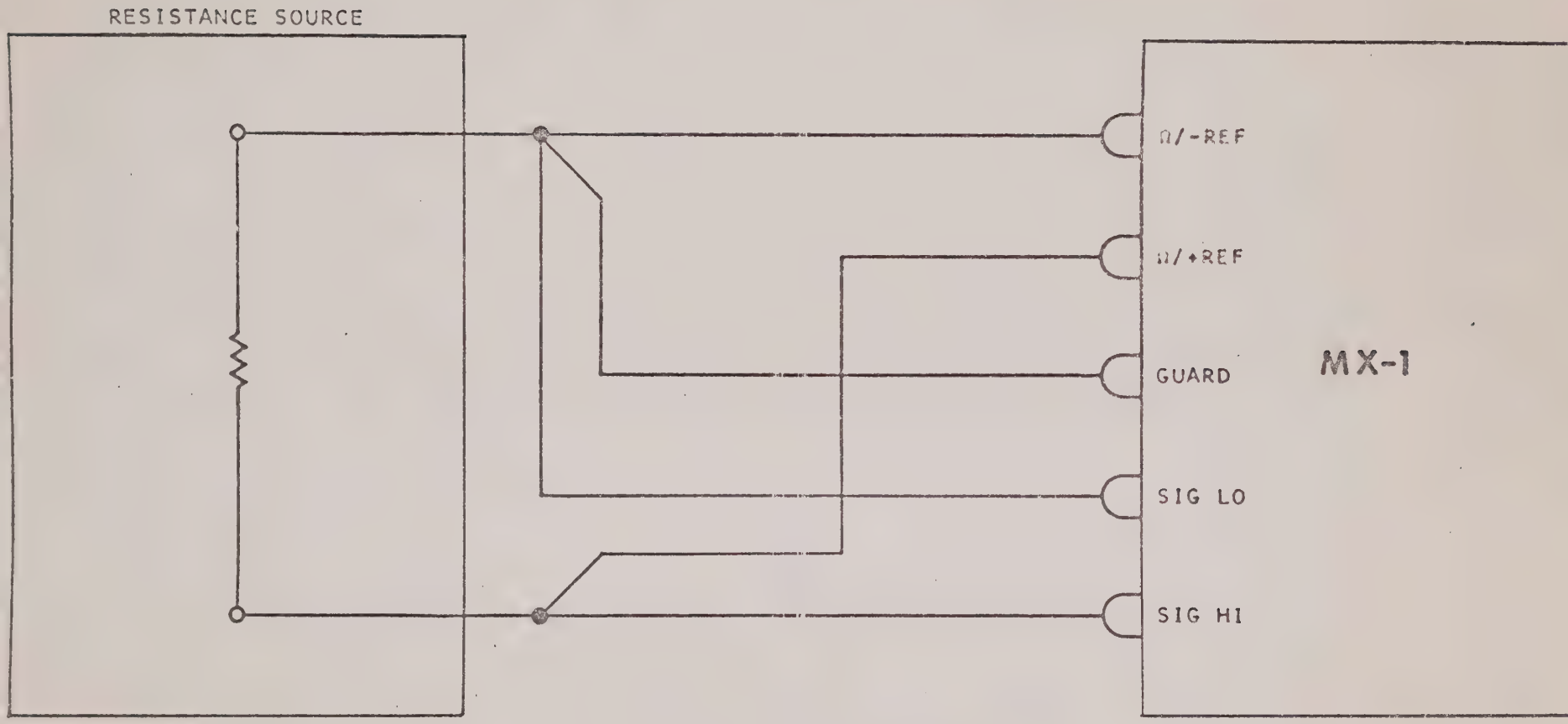


Figure 3-4. Ohms Adjustment Connections

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
AB	A		ADDED SHEET 2	9/8/72	
	B		ADDED R5 & R6 MATCHED SET	9/28/72	

(7404)

1 SIG GND
2 VDC
3 RATIO X10
4 +5V
5 DELAY
6 AUTO RANGE
7 DN RNG GATE
8 DN RNG PULSE
9 UP RNG PULSE
10 UP RNG GATE
11 2 } DECIMAL DRIVE IN
12 4
13 17VAC
14 -REF IN
15 +REF IN
16 17VAC
17 1 } DECIMAL DRIVE IN
18 8
19 +17V
20 -17V
21 +10V REF
22
23 LOGIC GND
24 POL INH.
25 GUARD
26 KΩ
27 VAC
28 BUF OUT

⚠ R5 & R6 MATCHED SET SEE #34-222

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED		CONTR. NO.		
DIMENSIONS ARE IN INCHES TOLERANCES ON		DRAWN	RWJ, CBM	8-28-72
DECIMALS ± .010	ANGLES ± 0° 30'	CHECK		
FRACTIONS ± 1/32		APPR		
MATERIAL		RELEASE DATE 9-12-72 RB		

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SIGNAL CONDITIONER SCHEMATIC

SIZE	CODE IDENT NO.	
D	03626	34-205

SCALE — WEIGHT SHEET 2

34-217	34-4	1	1
NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY
APPLICATION		QTY.	

8 (−) Y 22 Z X U W V T

DS1 DS2 2N3569 Q11 Q12 2N3569 R 12 2K R13 2K R14 2K R15 2K C21 MF 500V

U3 U2 U23 N7420A POLARITY FLIP-FLOP

500 KHZ OSC

R22 2K 2% R 54 10K 2% R57 15K 2% R16 2K 2% C27 CR12 TP12 (12) CR11 (2) IN914/IN4148 C28 130PF 500V Q36 Q37 SE1010/2N3904 (2)

R59 15K (6) V1 10° XV1 R90 15K (6) V2 10' XV2 R91 15K

R95 33K R96 33K R97 33K

U21 N7441B U20 N7441B U19

U16 N7475B U15 N7475B U14

U11 N7490A U10 N7490A U9

8 4 2 1 80 40 20 10

R50 10K Q19 2N3904 R77 100K R62 20K 2%

DS3 R11 2K Q2

R10 2K Q13 2N3569 R49 10K U2 Q22 2N3645 R48 10K

POL. INH.

3 2 27 4 25 22 14 15 28 1 21 23 20 19 / 12 18 17 11 24 5 9 8 7 10 6 26 13 16

TO SIG COND 34-205

U4

GUARD

FUNCTION OUTPUT

20 GUARD
9 KΩ
12 RATIO
13 DC
14 AC

* TO AC/DC CONV ON 34-205 SIG. COND. BD.

FRONT PANEL
BLK J12
RED J11
BLU J10
BLK J9
RED J8

REAR PANEL
RED J3 SIG HI
BLK J4 SIG LO
BLU J5 GUARD
RED J6 Ω/+ EXT REF
BLK J7 Ω/− EXT REF

TO DATA OUTPUT ASSY A1

+10V

OSCILLATOR GATE

CR 18 R80 100K

CR19 IN 4735 Q28 2N 3906 2N 3904 Q20 RG6 33K CR17

−17V

R101 51K

11 TP11

10 TP10

R3 100Ω 10 V RATIO ADJ

10 VDC ADJ R2 100Ω

U24 REFERENCE ASSY P/N 34-213

REF AMP IN +10V OVEN +17V GND −17V −17V REF AMP IN LO

REF CURRENT

U26 NULL AMP ASSY P/N 34-107

AMP OUT INPUT INT +17V GND −17

6 TP6 7 TP7

U25 INT. AMP. ASSY P/N 34-106

ADJ OUT INPUT INT +17V GND −17 BUF OUT SIG LO

1. OPTIONAL ACCESS
6. PART OF NEXT A
5. T.P. ARE TEST
4. RESISTORS AR
3. ALL DIODES AR
2. ON N7400A (U1,3 & N7420A (U23
1. HEAT SINK TO B

NOTES: UNLESS OTHERWISE SPECIFIED

REF. DESIGNATIONS NOT USED:
C23,25,13,14
CR10 J1,2
Q10,18,23,1,13,14,24,27.
R26,51-53,55,60,61,89,81,86,6,63,64,67-70,105,106
S5-7,8
W1

LAST REF. DESIGNATIONS USED: A1
C28
CR19, DS3, F1, J12
Q37
R106
S9, T1, TP12
U26, V6, XV6, W2

4 3 2 1

REVISIONS

ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

P S R N K M L J E H F D

R92 15K V4 10^3 XV4 — DO 1 2 3 4 5 6 7 8 9

R93 15K V5 10^4 XV5 — DO 1 2 3 4 5 6 7 8 9

R94 15K V6 10^5 XV6 — DO 1 2 3 4 5 6 7 8 9

R98 33K — U18 N7441B — 800 400 200 100

R99 33K — U17 N7441B — 80000 40000 20000 10000

2N1893 — R100 33K — Q30 — Q29 — R17 2K — R18 2K — R20 2K — R19 2K — 100,000 C — POL. & DIGIT OUTPUT

U13 N7475B — 8000 4000 2000 1000

U12 N7475B

U6 N7473A

U8 N7490A

U7 N7490A

R21 2K

U6 N7473A

R9 1K — R30 5.1K — C22 470pf 1000V — Q17 2N3904 — TP1

U22 N7441B — DECIMAL DRIVER — DOWN RANGE FLIP-FLOP

+5V — GND — B 2 1 A

2 4 8 1 — 4 5 3 7 — RANGE OUTPUT

R23 2K — R8 1K — R33 5.1K — R31 5.1K — R32 — R4 100Ω — R34 5.1K — CR13

C16 .01pf 150V — R58 15K — C24 470pf 1000V — Q26 2N3906 — CR14

MC830P U5 — UP — DN — RANGE CHANGE GATES — Q15 (2) 2N3904 — Q16 — R78 100K — R183 51K — TP2

U4 — U3

C25 12MF 250V — R24 220K ½W

RNG CHANGE ENABLE — +17V — +17V — UP+DOWN — DELAY CONTROL — 21 15 16 11 10

TO DATA OUTPUT ASSY A1

S2 AUTO RNG SW. — W2

S3 RNG CHNG SW. — R29 5.1K — C20 68pf 200V

R35 5.1K — R36 5.1K

R56 10K — C26 470pf 1000V — TP3

200 M.S. DELAY

R37 5.1K — R38 5.1K — R102 51K — R75 33K — R39 5.1K — R76 33K — C8 10MF 25V — R79 100K — C15 .01MF 150V — Q9 2N3569 — Q7 2N3569 — Q8 2N3569 — R40 5.1K — INPUT INTEGRATION FLIP-FLOP R41 5.1K

C19 .002MF 500V — R83 100K — R84 100K — R85 100K — CR9 IN4005 — CR16 — C17 .002MF 500V — C18 .002MF 500V

2N3645 — Q4 — Q35 TIP31A — R73 33K — R46 10K — R7 2K — R1 4.7Ω ½W — TP5 — +5V

C5 500MF 50V — C9 10MF 25V — C6 500MF 50V — CR2 — CR1 — CR3 — CR4 — IN4005 8 PLACES — YEL — YEL — GND BLU — CR5 BRN — CR6 BRN — CR7 — CR8 — C4 C3 C2 C1 1000MF 10V (4)

SEC #3 — SEC #2 — SEC #1 — T1

R42 5.1K 2% — TP4 — Q32 Q25 2N1893 (2) — R65 12K 2% — C11 10MF 25V — R74 15K — (2) 2N3645 Q5 Q21 — TIP 32A Q33 — R5 510Ω — R82 100Ω ½W — C7 47MF 6V — Q6 2N3569 — R47 10K — R44 5.1K 2% — R114 10K — R27 33K 2% — R28 33K — R43 5.1K 2% — Q2 — Q3 — R45 15K — 2N3645 — R72 33K 2% — C12 10MF 25V — C14 10MF 25V — C13 10MF 25V — C10 10MF 25V — C23 .0047MF 1000V — TP8 — R88 2K — R87 4.7Ω ½W — Q34 TIP 32A — R71 33K — Q31 2N1893

BLU — RED/WHT — BLK/WHT — PR #1 — RED — RED — PR #2 — GRY — WHT

REAR PANEL S9 — 115/230V SLIDE SW. — S4 PWR SW — LO — EARTH — HI — F1 FUSE 1/4A S.B.

POWER PUSH BUTTON → S1 (NO ELECTRICAL CONNECTIONS; MECHANICALLY LINKED TO S4)

ORY, NOT PART OF 34-214.

SEMBLY

POINTS.

E ¼W 5%

E 5003-002

7) MC846P(U2), MC830P(U5) PIN 7 CONNECTED TO GND, PIN 14 CONNECTED TO Vcc(+5V)

USED WITH Q33(TIP 32A)

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

34-217	34-4	1	1
NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010 — ANGLES ± 0° 30'
FRACTIONS ± 1/32

MATERIAL

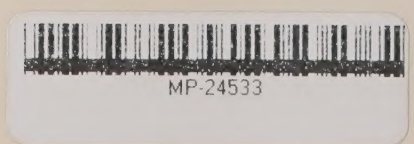
CONTR. NO.			
DRAWN	C. MEREDITH	8-28-72	
CHECK			
APPR			
RELEASE DATE 9-12-72 RB			

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

ASSY, MAIN BOARD
SCHEMATIC

SIZE	CODE IDENT. NO.	
E	03626	34-214

SCALE — WEIGHT — SHEET 2 OF 3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